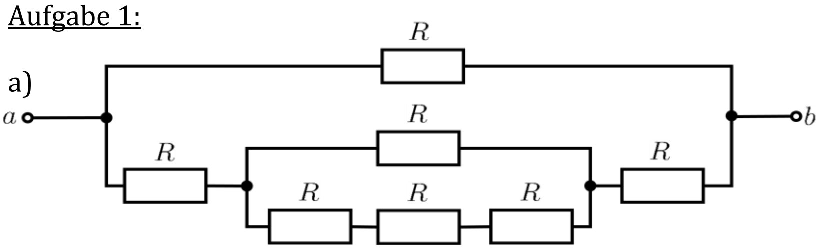
Musterlösung: „Einführung in die Elektrotechnik für Medienwissenschaftler" bzw. „Elektrotechnische Grundlagen der Technischen Informatik" : SS 15

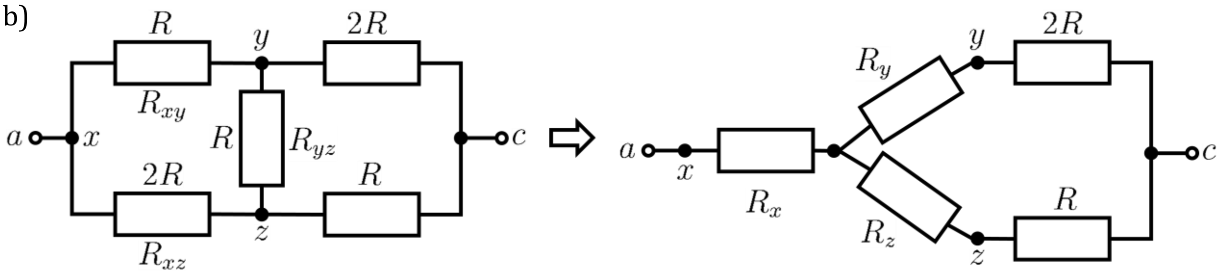
Aufgabe 1:

a)



$$R_{ab} = R||(2R + (R||3R)) = \frac{11}{15}R$$

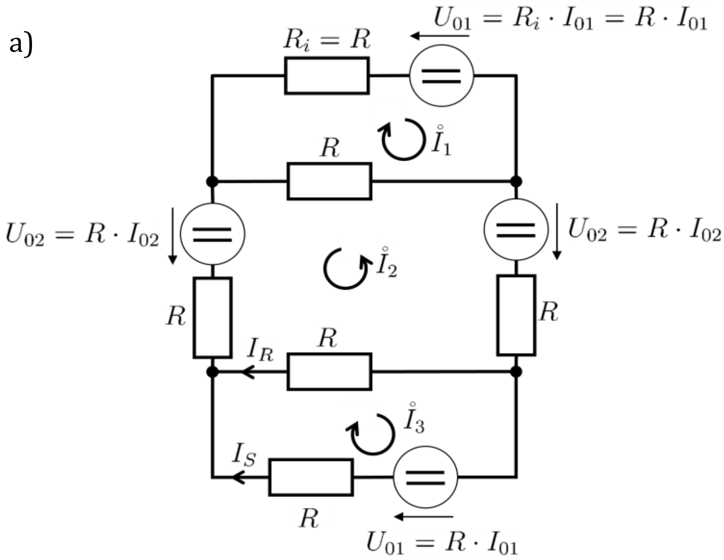
b)



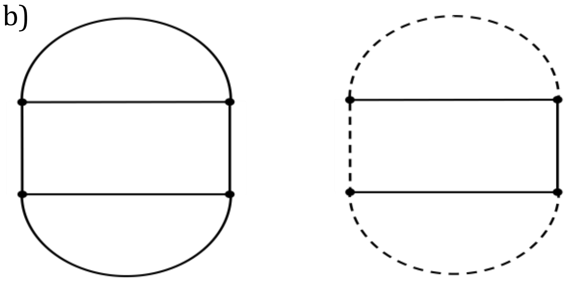
$$R_x = \frac{R_{xy}R_{xz}}{R_{xy}+R_{xz}+R_{yz}} = \frac{R}{2}$$
$$R_y = \frac{R_{xy}R_{yz}}{R_{xy}+R_{xz}+R_{yz}} = \frac{R}{4}$$
$$R_z = \frac{R_{xz}R_{yz}}{R_{xy}+R_{xz}+R_{yz}} = \frac{R}{2}$$
$$R_{ac} = R_x + ((R_y + 2R)||(R_z + R)) = \frac{7}{5}R$$

Aufgabe 2:

a)



b)



Zusammenhängender Graf Vollständiger Baum

c)

$$m = z - (k-1) = 6 - (4-1) = 3$$

d)

$$\begin{pmatrix} 2R & R & 0 \\ 0 & 4R & R \\ 0 & R & 2R \end{pmatrix} \cdot \begin{pmatrix} \mathring{I}_1 \\ \mathring{I}_2 \\ \mathring{I}_3 \end{pmatrix} = \begin{pmatrix} U_{01} \\ 0 \\ -U_{01} \end{pmatrix}$$

e) & f)

$\det(D) = 16R^3 - 2R^3 - 2R^3 = 12 \cdot 10^3 \Omega^3$
$\det(D_2) = -2U_{01}R^2 + 2U_{01}R^2 = 0$
$\det(D_3) = -8U_{01}R^2 + U_{01}R^2 + U_{01}R^2 = -12 \cdot 10^3 \text{V}\Omega^2$
$\mathring{I}_2 = \frac{\det(D_2)}{\det(D)} = 0\text{mA}$
$\mathring{I}_3 = \frac{\det(D_3)}{\det(D)} = -1\text{mA}$
$I_R = -\mathring{I}_3 - \mathring{I}_2 = 1\text{mA}$
$I_S = \mathring{I}_3 = -1\text{mA}$

Aufgabe 3:

a)

$$\underline{H}(jw) = \frac{\underline{U}_2(jw)}{\underline{U}_1(jw)} = \frac{R}{R+jwL} = \frac{1}{1+jw\frac{L}{R}}$$

b)

$$|\underline{H}(jw)| = \frac{1}{\sqrt{1+(\frac{wL}{R})^2}}$$
$$\varphi(w) = \arctan(0) - \arctan(\frac{\frac{wL}{R}}{1}) = -\arctan(\frac{wL}{R})$$

c)

$$|\underline{H}(jw=0)| = 1$$
$$|\underline{H}(jw \to \infty)| = 0$$
$$|\underline{H}(jw_g)| = \frac{H_{\max}}{\sqrt{2}} = \frac{1}{\sqrt{1+(w_g\frac{L}{R})^2}}$$
$w_g = \frac{R}{L}$, mit $H_{\max} = 1$

d)

$$\frac{\underline{U}_2'(jw)}{\underline{U}_1(jw)} = \frac{1}{2} \cdot \frac{\frac{2R \cdot R}{3R}}{jwL + \frac{2R \cdot R}{3R}} => \underline{U}_2'(jw) = \underline{U}_1(jw)\frac{\frac{1}{3}R}{\frac{2}{3}R+jwL}$$

e)

$$\underline{H}'(jw) = \frac{\underline{U}_2'(jw)}{\underline{U}_1(jw)} = \frac{\frac{1}{3}R}{\frac{2}{3}R+jwL}$$

f)

$$|\underline{H}'(jw)| = \frac{\frac{1}{3}R}{\sqrt{(\frac{2}{3}R)^2+(wL)^2}}$$
$$|\underline{H}'(jw=0)| = \frac{1}{2}$$
$$|\underline{H}'(jw \to \infty)| = 0$$
$$|\underline{H}'(jw_g)| = \frac{H'_{\max}}{\sqrt{2}} = \frac{\frac{1}{3}R}{\sqrt{(\frac{2}{3}R)^2+(wL)^2}}$$
$w_g' = \frac{\sqrt{2}}{3}\frac{R}{L}$, mit $H'_{\max} = \frac{1}{2}$

Die Grenzfrequenz ist um den Faktor $\frac{\sqrt{2}}{3}$ verschoben.

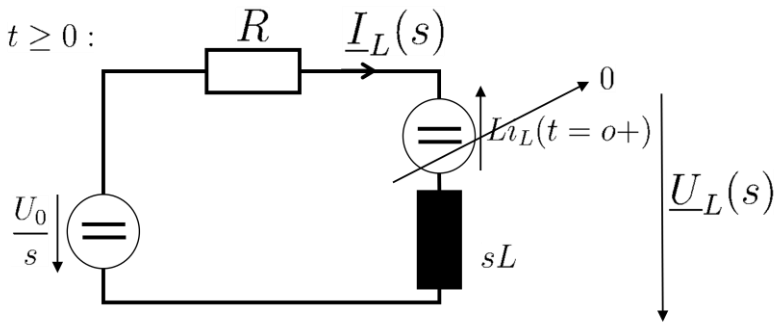
Die Maximale Übertragungsleistung ist um die Hälfte reduziert.

Aufgabe 4:

a)

$$i_L(t=o-) = i_L(t=o+) = 0$$

b)



c)

$$\underline{I}_L(s) = \frac{U_o}{s}\frac{1}{R+sL} = \frac{U_o}{R}\frac{\frac{R}{L}}{s(s+\frac{R}{L})}$$

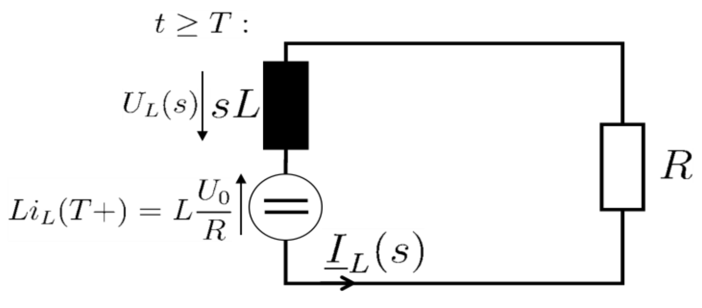
d)

$$i_L(t) = \frac{U_o}{R}(1 - \mathrm{e}^{-\frac{R}{L}t}), t \geq 0$$

e)

$$i_L(t=T-) = \lim_{t\to\infty} i_L(t) = \frac{U_0}{R}$$

f)



g)

$$\underline{I}_L(s) = \frac{L\frac{U_o}{R}}{R+sL}\mathrm{e}^{-sT} = \frac{U_0}{R}\frac{1}{s+\frac{R}{L}}e^{-sT}, t \geq T$$

h)

$$i_L(t) = \frac{U_0}{R}\mathrm{e}^{-\frac{R}{L}(t-T)}, t \geq 0$$